Journal of Catalysis

EDITORS:
W. Keith Hall — *Frank S. Stone*

EDITORIAL BOARD:
R. B. Anderson
M. Boudart
J. B. Butt
A. Cimino
R. P. Eischens
P. C. Gravelle
J. Haber
C. Kemball
G. W. Keulks
J. H. Lunsford
A. Nielsen
J. F. Roth
W. M. H. Sachtler
G. C. A. Schuit
P. W. Selwood
G. V. Smith
Z. G. Szabó
K. Tamaru
S. J. Thomson
P. B. Weisz

Volume 58 • 1979

ACADEMIC PRESS
New York and London
A Subsidiary of Harcourt Brace Jovanovich, Publishers

Copyright © 1979 by Academic Press, Inc.

All Rights Reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owner.

The appearance of the code at the bottom of the first page of an article in this journal indicates the copyright owner's consent that copies of the article may be made for personal or internal use, or for the personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated, per copy fee through the Copyright Clearance Center, Inc. (Operations Staff, P.O. Box 765, Schenectady, New York 12301), for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. Copy fees for pre-1979 articles are the same as those shown for current articles.

MADE IN THE UNITED STATES OF AMERICA

Contents of Volume 58

NUMBER 1, JUNE 15, 1979

A. A. DAVYDOV, A. A. YEFREMOV, V. G. MIKHALCHENKO, AND V. D. SOKOLOVSKII. The Surface Compounds and the Routes of Formation of the Reaction Products in the Interaction of Propylene with Zinc Oxide 1

P. A. ZHDAN, A. P. SHEPELIN, Z. G. OSIPOVA, AND V. D. SOKOLOVSKII. The Extent of Charge Localization on Oxygen Ions and Catalytic Activity on Solid State Oxides in Allylic Oxidation of Propylene 8

M. GĄSIOR, B. GRZYBOWSKA, J. HABER, T. MACHEJ, AND J. ZIÓŁKOWSKI. Oxidation of *O*-Xylene on Potassium Vanadates 15

M. MIYAKE, H. YONEYAMA, AND H. TAMURA. An Electrochemical Study of the Photocatalytic Oxidation of Methanol on Rutile 22

M. E. BRIDGE, C. M. COMRIE, AND R. M. LAMBERT. Hydrogen Chemisorption and the Carbon Monoxide–Hydrogen Interaction on Cobalt (0001) 28

J. C. CONESA, A. CORTES, J. MARTI, J. L. SEOANE, AND J. SORIA. Characterization of Nickel–Tungsten Mixed Oxides Supported on α-Alumina 34

R. Z. C. VAN MEERTEN, A. MORALES, J. BARBIER, AND R. MAUREL. Isotope Effects in the Hydrogenation and Exchange of Benzene on Platinum and Nickel 43

YVES BOUDEVILLE, FRANÇOIS FIGUERAS, MICHEL FORISSIER, JEAN-LOUIS PORTEFAIX, AND JACQUES C. VEDRINE. Correlations between X-Ray Photoelectron Spectroscopy Data and Catalytic Properties in Selective Oxidation on Sb–Sn–O Catalysts 52

Y. M. CROSS AND D. R. PYKE. An X-Ray Photoelectron Spectroscopy Study of the Surface Composition of Tin and Antimony Mixed Metal Oxide Catalysts 61

H. J. HERNIMAN, D. R. PYKE, AND R. REID. An Investigation of the Relationship between the Bulk and Surface Composition of Tin and Antimony Mixed Oxide Catalysts and the Oxidative Dehydrogenation of 1-Butene to Butadiene 68

ICHIRO NAKABAYASHI, TAKEO HISANO, AND TOSHIO TERAZAWA. Activity and Hydrogen Content of a Plate-Type Raney Nickel Catalyst 74

YASUAKI OKAMOTO, NOBUMASA ISHIDA, TOSHINOBU IMANAKA, AND SHIICHIRO TERANISHI. Active States of Rhodium in Rhodium Exchanged Y Zeolite Catalysts for Hydrogenation of Ethylene and Acetylene and Dimerization of Ethylene Studied with X-Ray Photoelectron Spectroscopy 82

P. BILOEN, J. N. HELLE, AND W. M. H. SACHTLER. Incorporation of Surface Carbon into Hydrocarbons during Fischer–Tropsch Synthesis: Mechanistic Implications 95

Z. PAÁL, G. SZÉKELY, AND P. TÉTÉNYI. Thermodynamics and Kinetic Effects in Platinum—Catalyzed *n*-Hexane Transformations 108

J. R. ANDERSON, K. FOGER, T. MOLE, R. A. RAJADHYAKSHA, AND J. V. SANDERS. Reactions on ZSM-5-Type Zeolite Catalysts 114

JACK C. SUMMERS AND SUSAN A. AUSEN. Interaction of Cerium Oxide with Noble Metals 131

NOTES

I. I. LEVITSKII, A. M. GYUL'MALIEV, AND E. A. UDAL'TZOVA. On the Mechanism of Alkane Hydrogenolysis 144

J. B. Benziger, E. I. Ko, and R. J. Madix. The Decomposition of Formic Acid on W(100) and W(100)-(5 × 1) C Surfaces 149

Number 2, June 30, 1979

Katsuomi Takehira, Hubert Mimoun, and Irénée Sérée De Roch. Liquid Phase Diacetoxylation of 1,3-Butadiene with Pd–Te–C Catalyst 155
John G. Ekerdt and Alexis T. Bell. Synthesis of Hydrocarbons from CO and H_2 over Silica-Supported Ru: Reaction Rate Measurements and Infrared Spectra of Adsorbed Species 170
Periaswamy Ramamoorthy and Richard D. Gonzalez. Surface Characterization of Supported Pt–Ru Bimetallic Clusters Using Infrared Spectroscopy 188
N. Davidova, N. Peshev, and D. Shopov. Some Aspects of the Bifunctional Action of Nickel–Zeolite Catalysts in the Conversion of Toluene 198
R. L. Moss, D. Pope, B. J. Davis, and D. H. Edwards. The Structure and Activity of Supported Metal Catalysts. VIII. Chemisorption and Benzene Hydrogenation on Palladium/Silica Catalysts 206
R. Burch. The Selective Isomerization of *n*-Hexane over Nickel on Silica–Alumina Catalysts 220
J. B. Nagy, M. van Eenoo, and E. G. Derouane. Highly Dispersed Supported Iron Particles from the Decomposition of Iron Carbonyl on HY Zeolite 230
John M. Adams, James A. Ballantine, Samuel H. Graham, Richard J. Laub, J. Howard Purnell, Paul I. Reid, Wafa Y. M. Shaman, and John M. Thomas. Selective Chemical Conversions Using Sheet Silicate Intercalates: Low-Temperature Addition of Water to 1-Alkenes 238
C. Joseph Machiels and Robert B. Anderson. Hydrogenolysis of Propane on Supported Catalysts of Nickel, Cobalt, Iron, and Ruthenium 253
C. Joseph Machiels and Robert B. Anderson. Hydrogenolysis of 2,3-Dimethylbutane on Supported Ruthenium, Nickel, Cobalt, and Iron 260
C. Joseph Machiels and Robert B. Anderson. Hydrogenolysis of 2,2-Dimethylbutane and *n*-Hexane over Supported Ruthenium, Nickel, Cobalt, and Iron .. 268
A. Hoek and W. M. H. Sachtler. Enantioselectivity of Nickel Catalysts Modified with Tartaric Acid or Nickel Tartrate Complexes 276
R. Kramer and M. Andre. Adsorption of Atomic Hydrogen on Alumina by Hydrogen Spillover 287
Yoshihiro Shigemasa, Tsuyoshi Taji, Chikahiro Sakazawa, Ruka Nakashima, and Teruo Matsuura. Formose Reactions. VIII. Solvent Effects in the Formose Reaction 296
T. Matsushima, M. Hashimoto, and I. Toyoshima. On the Kinetics and Mechanism of the CO Oxidation over Polycrystalline Iridium 303
A. Ohya, K. Urabe, K. Aika, and A. Ozaki. Potassium–Dinitrogen-Ruthenium Complex as an Active Catalyst for Nitrogen Fixation 313
Duncan E. McBride and James T. Hall. A Catalytic Reaction on Alumina Studied by Tunneling Spectroscopy: Transfer Hydrogenation of Muconic Acid 320

Note

A. Ignatiev and T. Matsuyama. Relationship of Surface Composition to Enhanced Methanation Activity over Cobalt Single Crystals 328

LETTER TO THE EDITORS

J. J. ROONEY. The Mechanism of Hydrogenolysis of Neopentane on Platinum Catalysts 334

NUMBER 3, JULY 1979

G. B. RAUPP AND W. N. DELGASS. Mössbauer Investigation of Supported Fe and FeNi Catalysts. I. Effect of Pretreatment on Particle Size 337
G. B. RAUPP AND W. N. DELGASS. Mössbauer Investigation of Supported Fe and FeNi Catalysts. II. Carbides Formed by Fischer–Tropsch Synthesis 348
G. B. RAUPP AND W. N. DELGASS. Mössbauer Investigation of Supported Fe Catalysts. III. *In Situ* Kinetics and Spectroscopy during Fischer–Tropsch Synthesis 361
SAMUEL SIEGEL, JAMES OUTLAW, JR., AND NISSIM GARTI. The Kinetics, Stereochemistry, and Mechanism of Hydrogenation of Some Tertbutylbenzenes on a Rhodium Catalyst 370
ARNE ANDERSSON AND STEN T. LUNDIN. Activities of Vanadium Oxides in Ammoxidation of 3-Picoline 383
V. INDOVINA, A. CIMINO, M. INVERSI, AND F. PEPE. Effect of Cobalt Ion Dispersion on H_2–D_2 Equilibration and Other Simple Reactions Catalyzed by CoO–MgO Solid Solutions 396
MAKOTO EGASHIRA, KATSUHIDE MATSUO, SHUICHI KAGAWA, AND TETSURO SEIYAMA. Phase Diagram of the System Bi_2O_3–MoO_3 409
SUKRITI B. KANUNGO. Physicochemical Properties of MnO_2 and MnO_2–CuO and Their Relationship with the Catalytic Activity for H_2O_2 Decomposition and CO Oxidation 419
M. ZDRAŽIL. Sorption on Hydrodesulfurization Catalysts 436
SHIGERU TSURUYA AND TAKASHI YOSHIMATSU. Basic Copper(II)-Catalyzed Halogen Displacement Polymerization of 2,4,6-Trihalogenophenols 444
SHUN C. FUNG. Application of XPS to the Determination of the Size of Supported Particles in a Catalyst—Model Development and Its Application to Describe the Sintering Behavior of a Silica-Supported Pt Film 454
G. M. MUHA. On the Electron Donor and Electron Acceptor Properties of the γ-Alumina Surface 470
G. M. MUHA. On the Redox Properties of Certain Oxide Surfaces 478

NOTES

NORVELL NELSON AND RICARDO B. LEVY. The Organic Chemistry of Hydrodenitrogenation 485
R. J. MIKOVSKY, J. F. MARSHALL, AND W. P. BURGESS. Aluminum Distribution in Four-Rings and Six-Rings of the Faujasite Lattice 489

LETTERS TO THE EDITORS

BURTON H. DAVIS. Inductive Effects and Product Distributions in the Dehydration of Secondary Alcohols on Alumina 493

Dirk Dautzenberg and Helmut Knözinger. Inductive Effects and Product Distributions in the Dehydration of Secondary Alcohols on Alumina. Reply to the Comments by B. H. Davis 496

Author Index for Volume 58 498

Subject Index for Volume 58 will appear in the December issue as part of a cumulative index for the year 1979.

our catalysis problem may have already been solved by orton Company. Our experience in the design, develop- ent, and manufacture of catalyst carriers spans more than 5 years. We offer a wide variety of shapes, sizes, and aterials as "standards". We also have the experience, boratory facilities, and pilot plant to alter the character- tics of our carriers — or develop new ones — to meet your articular requirements.

/ide choice of materials, shapes

Alundum® or other fused or sintered aluminas • Silica S" • Crystolon® "C" — silicon carbide • Zeolon® — Mole- ular Sieves • Zircon, Zirconia "Z" • Spinel "X" — MgO Al_2O_3.

apes include Rings, Spheres, Stars, Pellets, Saddles, ggregate and Fluidizable forms.

ow Surface Area Carriers ($<1\ m^2/gm$).

ow surface area catalyst carriers are a Norton specialty. e offer the industry's widest selection — over 125 standard pes. However, if one of these doesn't meet the unique equirements of your system, Norton welcomes the challenge develop a carrier that will.

ur experience with crystalline materials and our exact- g control of the way we process, fire, bond or form our arriers enable us to alter their characteristics to provide e physical properties you need.

ntermediate Surface Area (1-100 m^2/gm.)

ood mechanical strength combined with high catalytic ctivity make Norton ISA catalyst carriers the preferred aterial for high yield and long life catalysts.

igh Surface Area ($>100\ m^2/gm$.)

addition to a broad line of standard HSA carriers, orton is prepared to develop specialized carriers with properties to handle your specific catalysis needs.

Important Physical Properties

You may specify pore size distribution, structure, surface area, and other physical properties with complete confidence in Norton's ability to meet them.

Through careful selection of raw materials, precise control of processing and thorough testing, Norton catalyst carriers consistently meet or exceed these important criteria:
• Uniformity • Low Attrition Loss • Chemical Inertness • High Thermal Shock Resistance • High Crush Strength

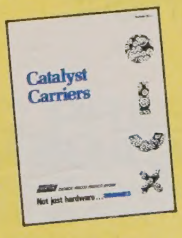
Pilot plant quantities of carriers can be supplied for your use . . . with the assurance of product duplication in commercial quantities.

Other Norton Catalysis Products

NC-100 Gas Atmosphere Catalyst, nickel as nickel oxide on a non-alumina support. Primarily utilized in exothermic and endothermic gas generators and in ammonia dissociation.

Zeolon® Acid Resistant Molecular Sieves for adsorption (e.g., NO_x and SO_2), ion exchange (e.g., cesium) and catalysis. High uniformity of pore openings and excellent chemical stability make Zeolon molecular sieves perform in systems that would harm or even destroy other adsorbents.

Denstone® Ceramic Catalyst Bed Supports are offered in both balls and pellets. Outstanding properties include low porosity, catalytic inertness, and long operating life.



Bulletin CC-11 is packed with useful data on the selection of Norton catalyst carriers, complete with detailed chemical analyses/physical properties tables for each type. If you'd like a copy, just write to Norton at the address below.

-061

NORTON CHEMICAL PROCESS PRODUCTS
P.O. BOX 350 AKRON, OHIO 44309 TEL: (216) 673-5860

Akron, Atlanta, Chicago, Houston, Los Angeles, New York • Burlington, Canada • Mexico City, Mexico
Stoke-on-Trent, England • Lidcombe, Australia • Conflans, France • The Hague, Holland • West Germany

Academic Press publishes books and journals in many areas of chemistry and chemical engineering including:

biochemistry
environmental chemistry
industrial and applied chemistry
inorganic chemistry
macromolecular chemistry
materials chemistry
organic chemistry
physical chemistry

For a list of titles in your subject area, please write to the publisher, attention: Sales Department.

AP 7399

ACADEMIC PRESS
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX

"It is not possible to be active in catalytic chemistry and ignore the important contribution of this series."
—JOURNAL OF THE FRANKLIN INSTITUTE

ADVANCES IN CATALYSIS

Edited by D. D. ELEY, HERMAN PINES, and PAUL B. WEISZ

REVIEWS OF PUBLISHED VOLUMES:

". . . indispensable to all laboratories where there is active research in heterogeneous catalysis." **—NATURE**

". . . should be in the hands of all who are interested in catalysis . . ." **—SCIENCE PROGRESS**

"As usual, anyone interested in catalytic processes cannot afford to be without an personal copy."
—TRANSACTIONS OF THE FARADAY SOCIETY

Complete information on each volume in the series is available on request.

Take advantage of the convenience of our Continuation Order Plan: Your CONTINUATION ORDER authorizes us to ship and bill each volume automatically, immediately upon publication. This order will remain in effect until cancelled. Please specify volume number with which your order is to begin. Please direct all inquiries and orders to the Sales Department.

AP 7402

ACADEMIC PRESS
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX

"... adds considerably to the literature in series." —NATURE

ADVANCES IN HETEROCYCLIC CHEMISTRY

Edited by ALAN R. KATRITZKY and A. J. BOULTON

This series provides a thorough analysis and review of the extensive work underway in heterocyclic chemistry. Researchers in the fields of organic chemistry, chemical and industrial engineering, and students in chemistry and engineering, will find that the articles in this authoritative series treat, extensively, progress in the field of heterocyclic chemistry. The bibliograhic references accompanying each article act as a pathway to the literature of heterocyclic chemistry.

"... an excellent work ... can be whole-heartedly recommended for students and research workers in the field of organic chemistry ... many will look forward keenly to subsequent volumes in this important area."
—SCIENCE

"... thorough and authoritative and will be very useful."
—JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

"The latest two volumes of this ... publication fully maintain the standards established during the past four years, with a selection of timely reviews on both general and specialist aspects of the subject. No one ... can fail to find interest in at least some of the material, while to the research worker active in heterocyclic chemistry this series must be an important part of his library."
—NATURE

Complete information on each volume in the series is available on request.

Take advantage of the convenience of our Continuation Order Plan: Your CONTINUATION ORDER authorizes us to ship and bill each volume automatically, immediately upon publication. This order will remain in effect until cancelled. Please specify volume number with which your order is to begin. Please direct all inquiries and orders to the Sales Department.

AP 7408

ACADEMIC PRESS
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX